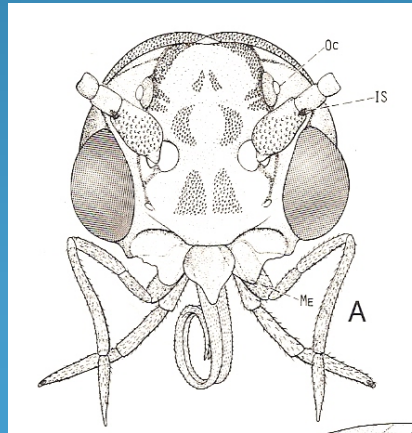
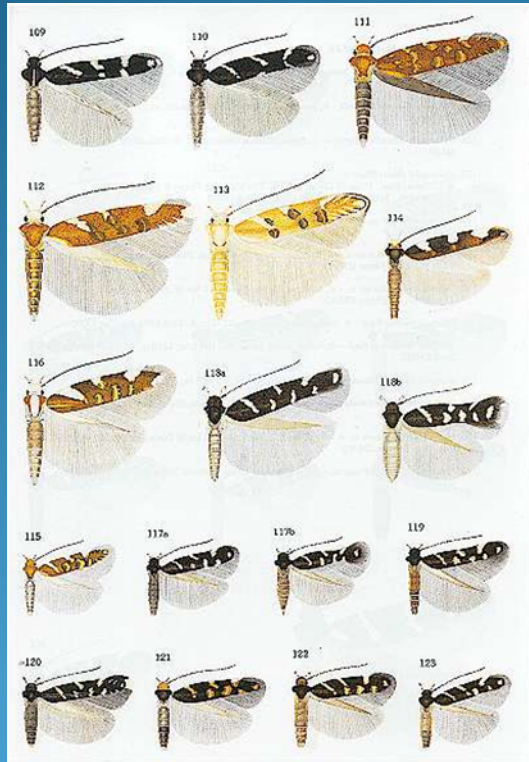


# AN INTRODUCTION TO MICROLEPIDOPTERA:

Phylogeny, Classification,  
Diversity, and Morphology  
(gag me with a spoon)



# General Remarks



- Microlepidoptera – a category of convenience (not all are small).
- Approximately 35% of the species in the order (described, that is).
- Majority of the fundamental developments or innovations characteristic of the order take place within microlepidoptera.
- Phylogeny is poorly understood (but its getting better).

# Major Innovations: Modification of mouthparts

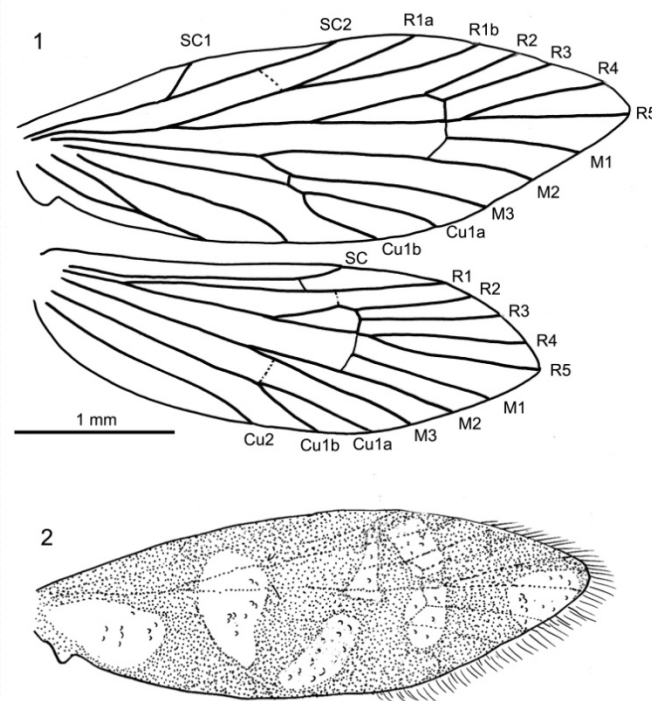


mandibulate  
primitive

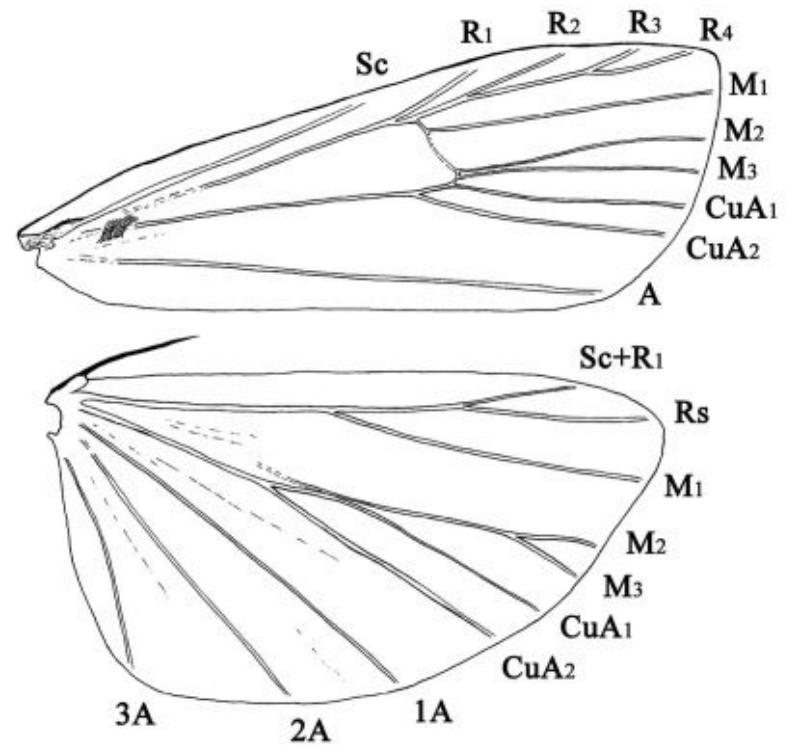


haustellate  
advanced

# Major Innovations: Modification of the wing venation



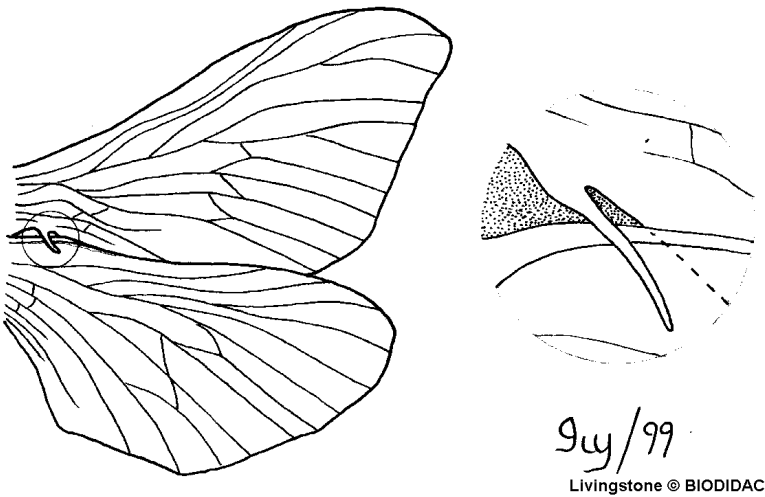
homoneurous  
primitive



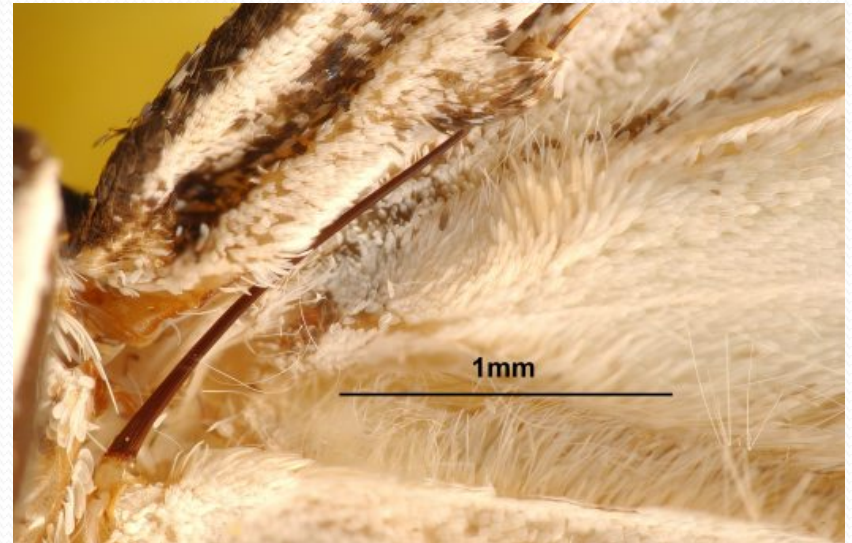
heteroneurous  
advanced

# Major Innovations:

## Modification of the wing coupling



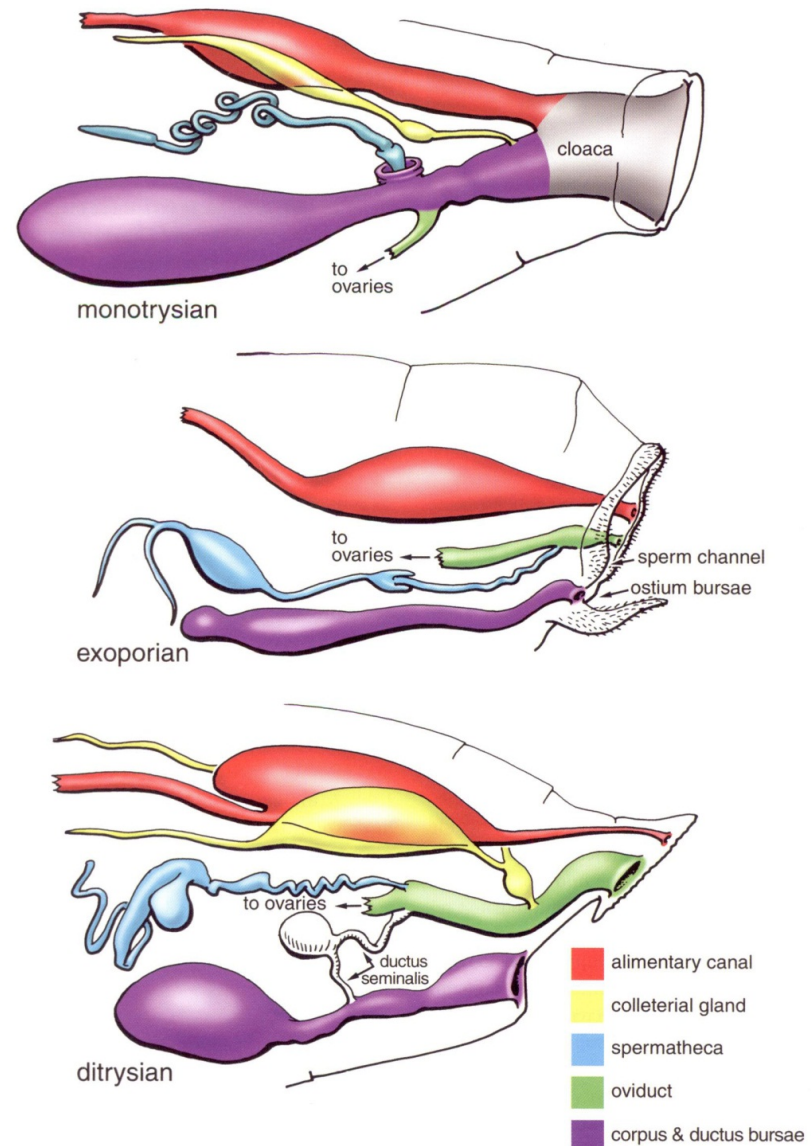
jugate coupling  
primitive



frenate coupling  
advanced

# Modification of the female reproductive system

- Monotrysia (primitive)
  - Common opening for copulation and oviposition
- “Exoporia”
  - Separate opening for copulation and oviposition; the sperm migrates externally to the ovipore.
- Ditrysia (advanced)
  - Separate openings for copulation and oviposition; connected internally by the ductus seminalis
  - 98% of all Lepidoptera



# Overview of Presentation

- Briefly summarize classification based on phylogeny from Kristensen (1998, 2007), with a few minor modifications.
- Briefly discuss major lineages and morphological developments that define them (from Zeugloptera to Obtectomera); focus on wings (venation and coupling), female reproductive system, and mouthparts. **Major innovations in red!**

# Kristensen 1998 Handbook of Zoology

Two more recent  
phylogenies based on  
large molecular data sets.

A new classification  
proposed based on those  
phylogenies and a few  
other published and  
unpublished studies.

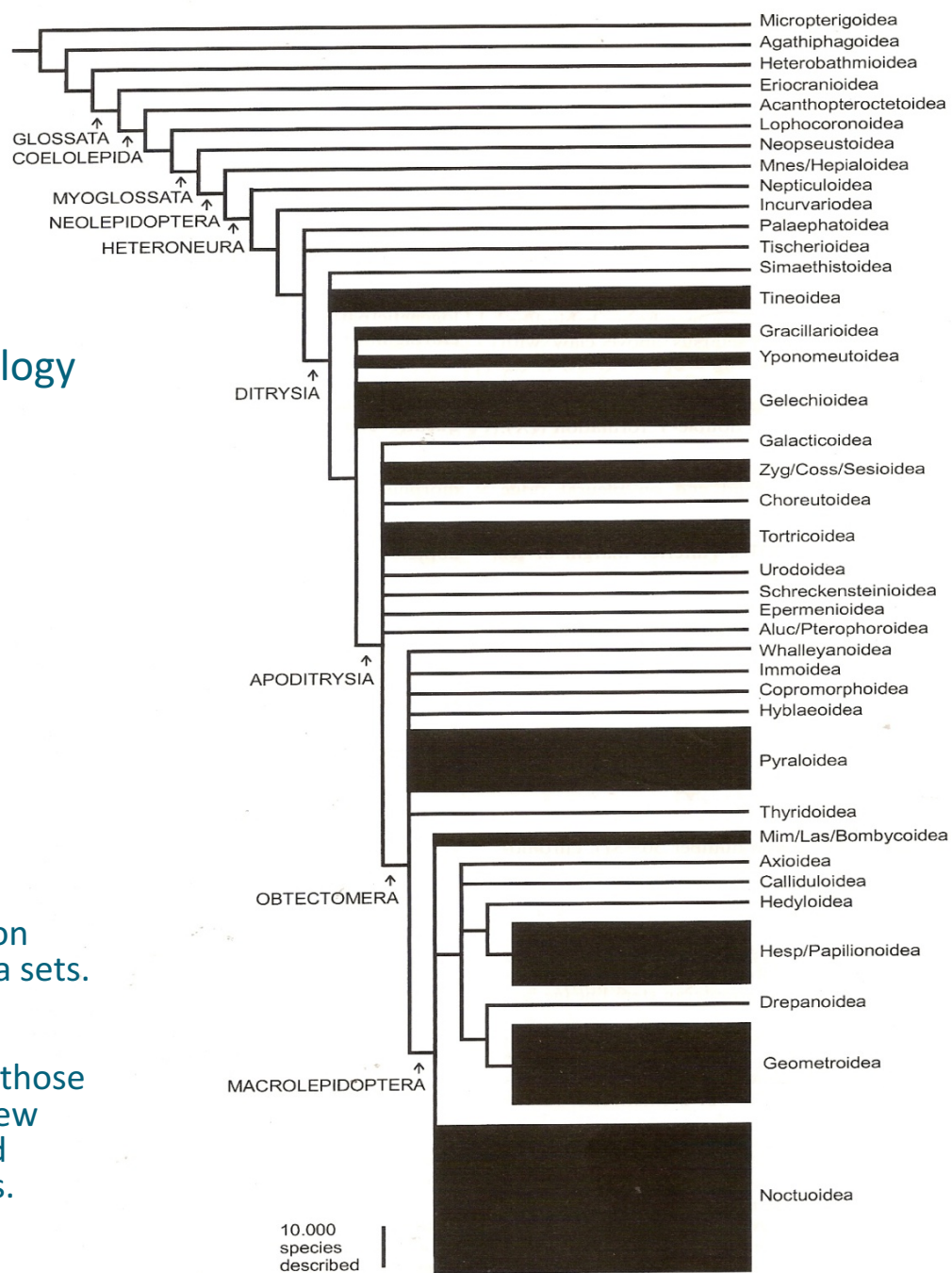


Fig. 2.2. Phylogeny of extant lepidopteran superfamilies. Width of superfamily lines indicate approximate numbers of described extant species (where these numbers are > 1000). Large sectors within the Ditrysia remain unresolved, and *all* proposed groupings above superfamily level in the Ditrysia must be considered *very* tentative.

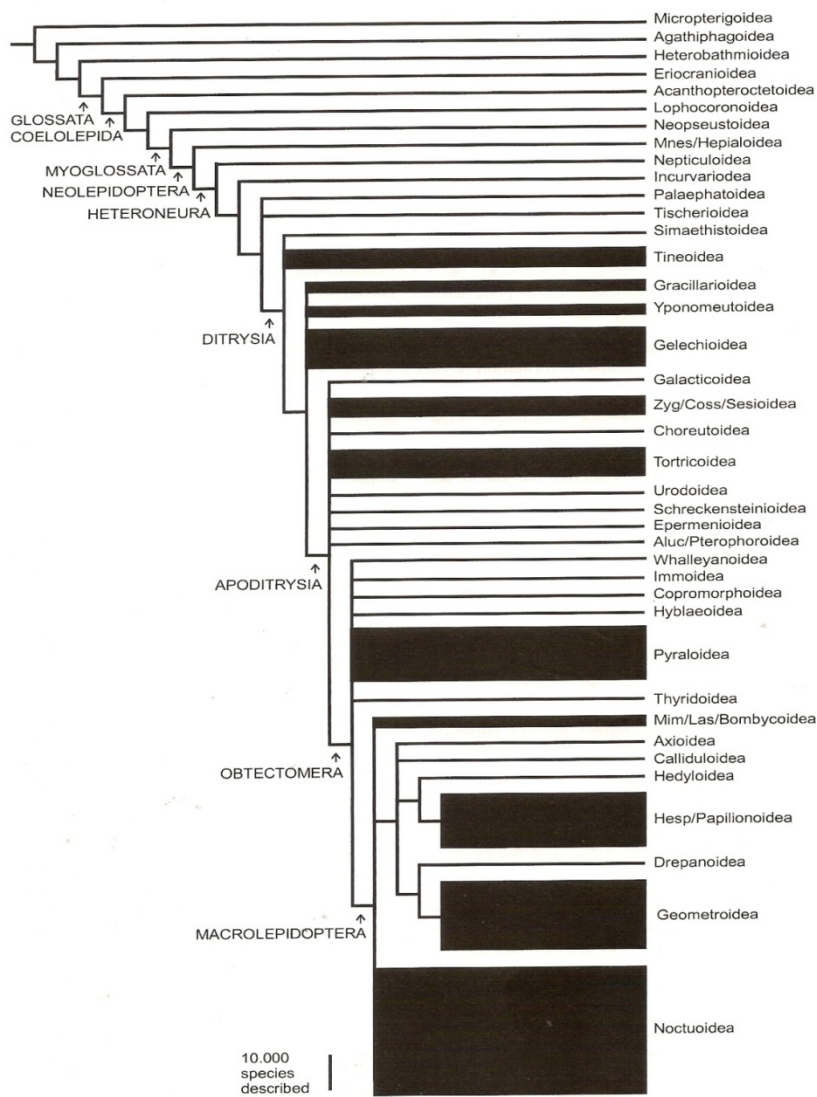
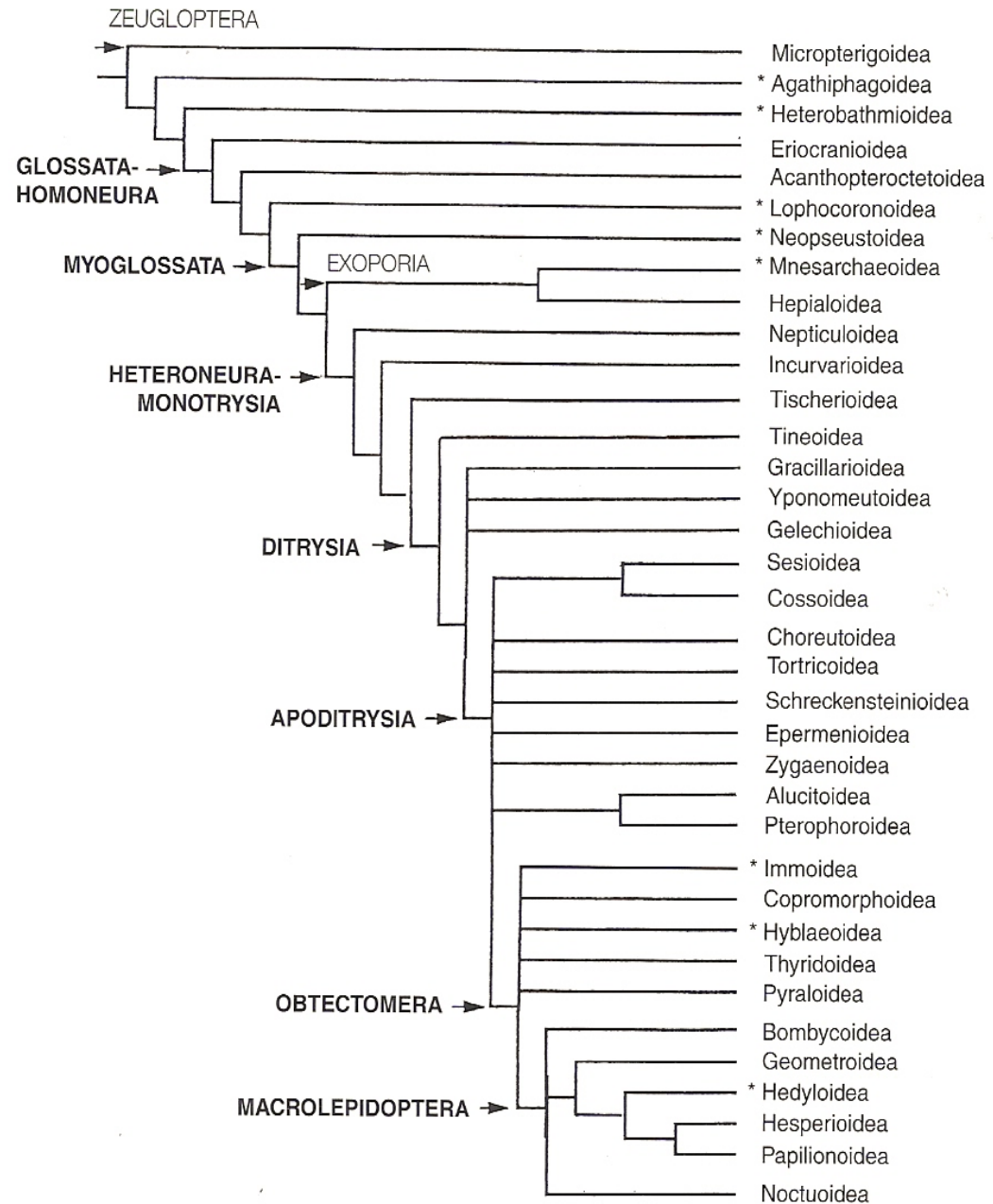
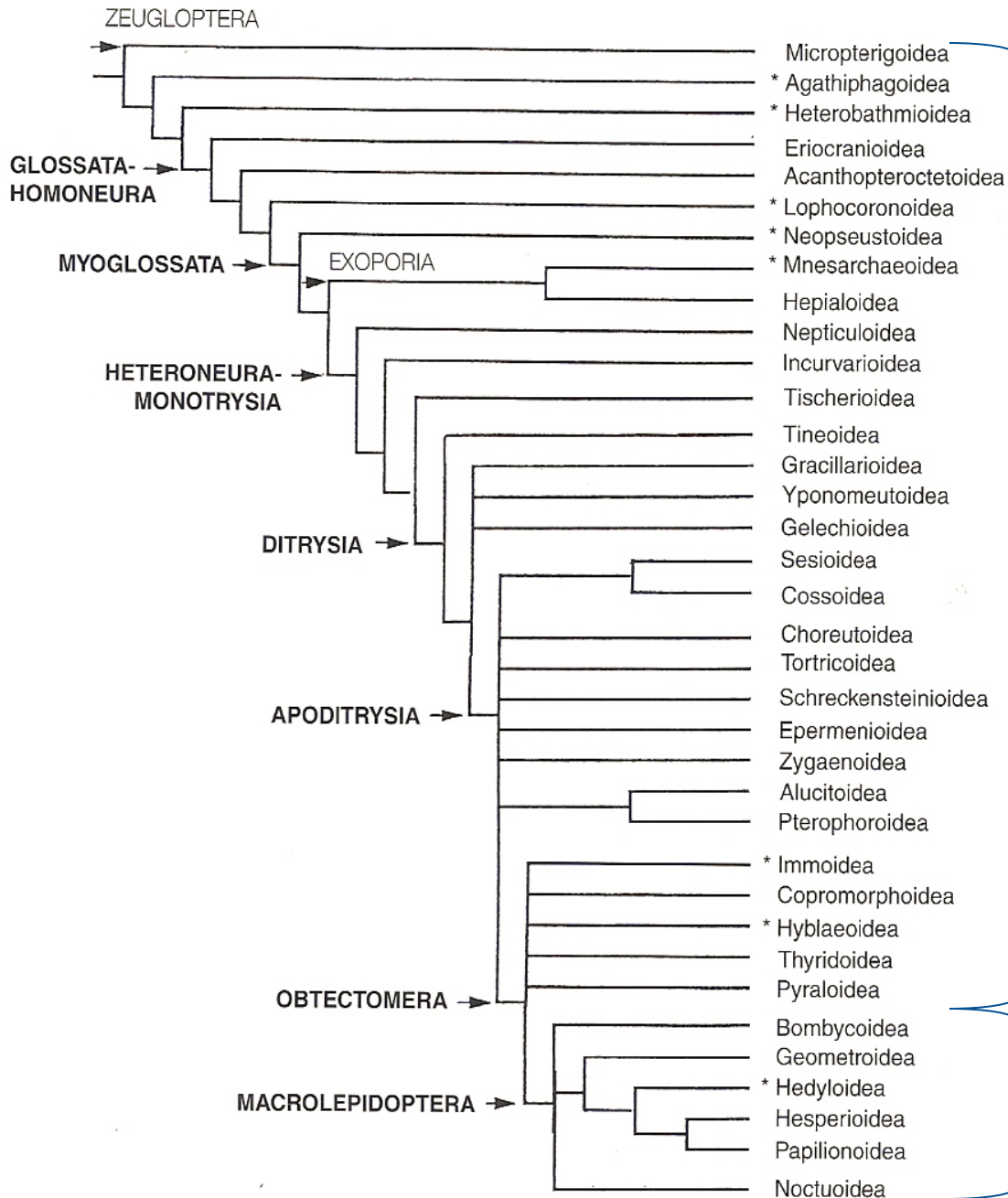


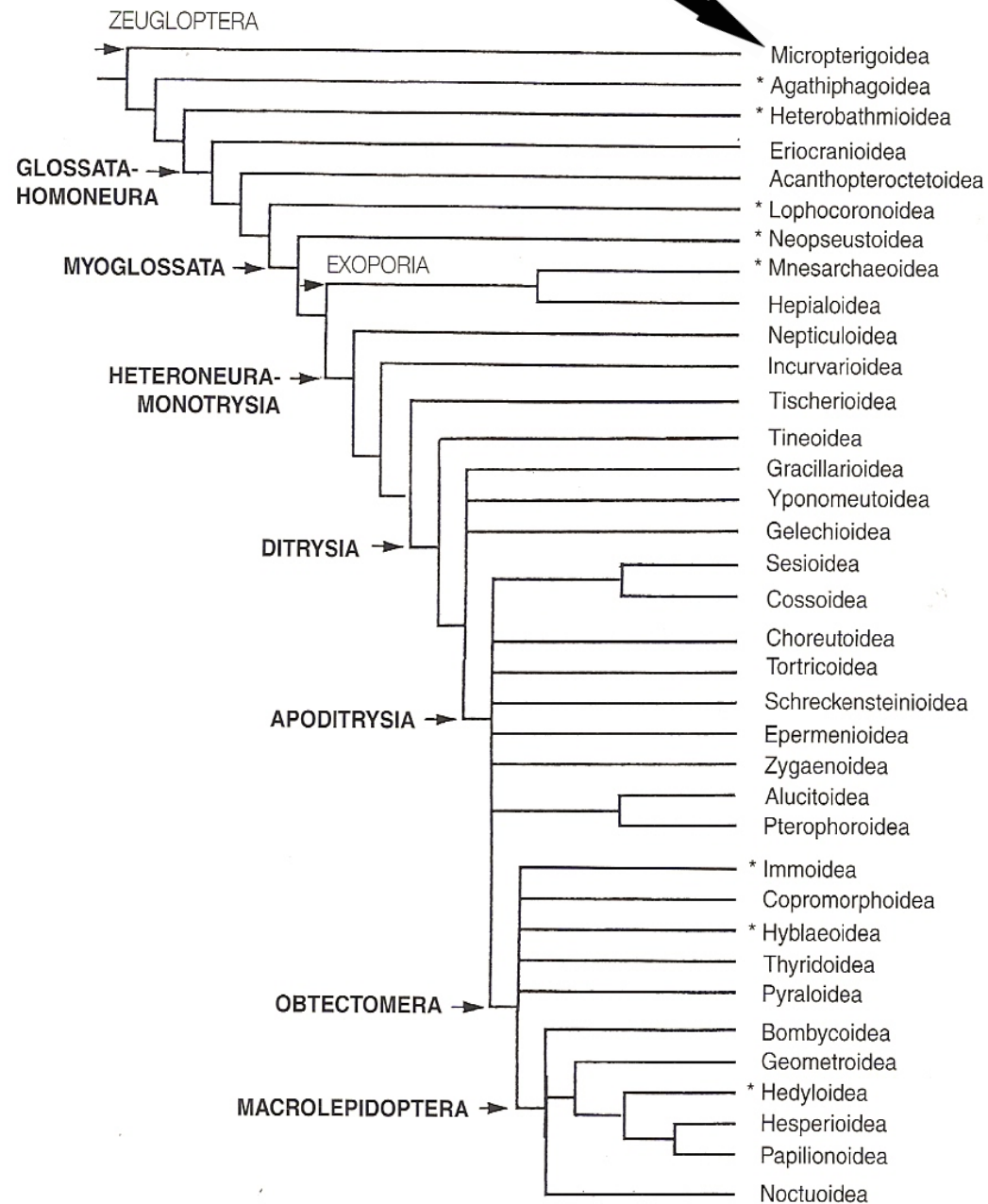
Fig. 2.2. Phylogeny of extant lepidopteran superfamilies. Width of superfamily lines indicate approximate number of described extant species (where these numbers are > 1000). Large sectors within the Ditrysia remain unresolved and all proposed groupings above superfamily level in the Ditrysia must be considered very tentative.





**Microlepidoptera and Pyraloidea**  
 35% of the species diversity  
 75% of the family diversity

**Macrolepidoptera**  
 65% of the species diversity  
 25% of the family diversity



# Micropterigidae (Zeugloptera)

- 1 family with 121 described species

Tiny diurnal moths, 10 mm or less, resembling caddisflies

Fuzzy head

Metallic colored wings

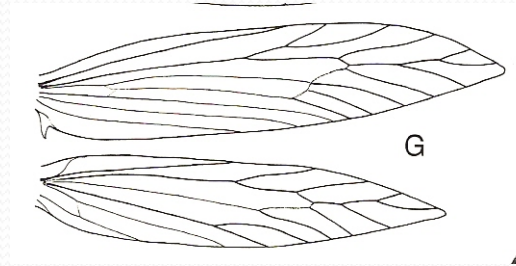
Larvae feed on liverworts, decomposing angiosperms, and fungal hyphae

Adults have mandibles (!) and feed on spores and pollen



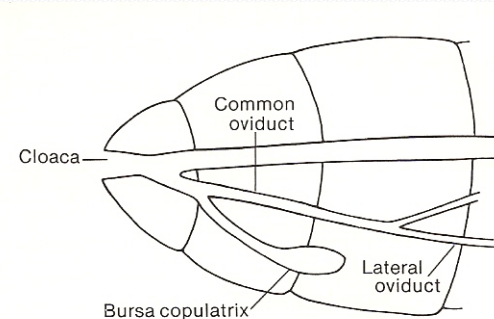
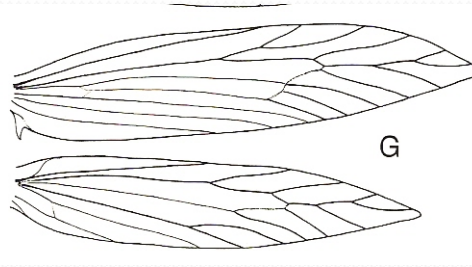
# Micropterigidae (Zeugloptera)

- 1 family with 121 described species
- Homoneurous wings; jugate wing coupling



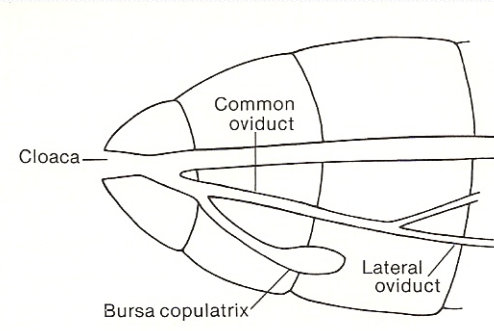
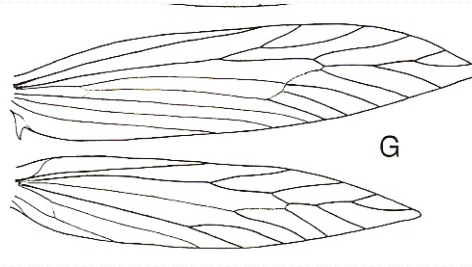
# Micropterigidae (Zeugloptera)

- 1 family with 121 described species
- Homoneurous wings; jugate wing coupling
- Monotrysian female reproductive system



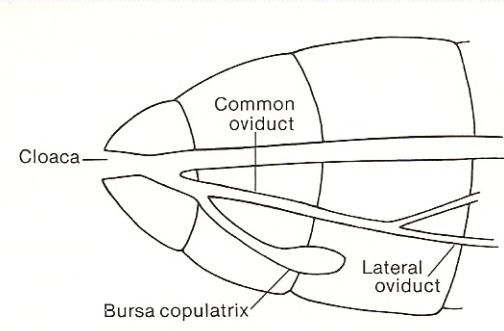
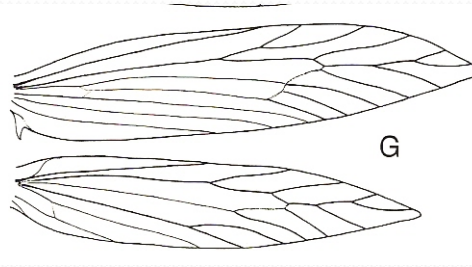
# Micropterigidae (Zeugloptera)

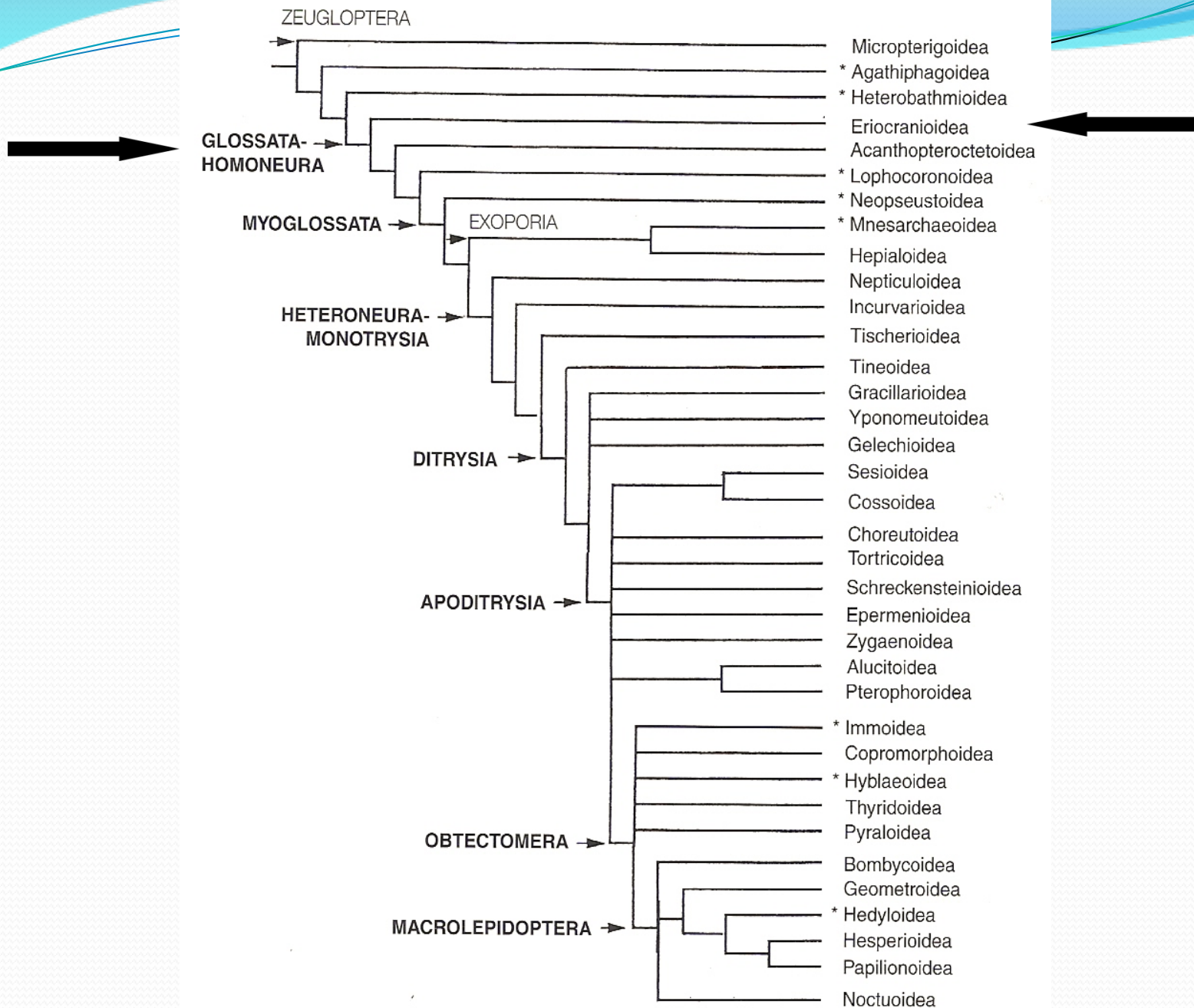
- 1 family with 121 described species
- Homoneurous wings; jugate wing coupling
- Monotrysian female reproductive system
- Strongly asymmetrical mandibles, short labial palpi



# Micropterigidae (Zeugloptera)

- 1 family with 121 described species
- Homoneurous wings; jugate wing coupling
- Monotrysian female reproductive system
- Strongly asymmetrical mandibles, short labial palpi
- Scaled wings!





# Eriocraniidae (Glossata)

- 1 family with 24 described species

Tiny moths, 10 mm or less

Fuzzy head

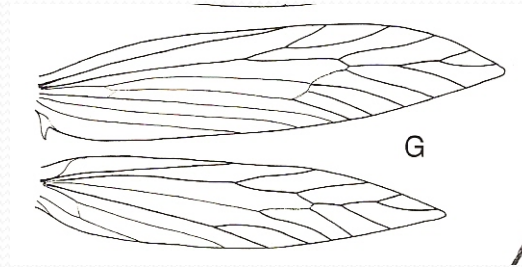
Metallic colored wings

Larvae are leaf-miners,  
primarily in Fagaceae



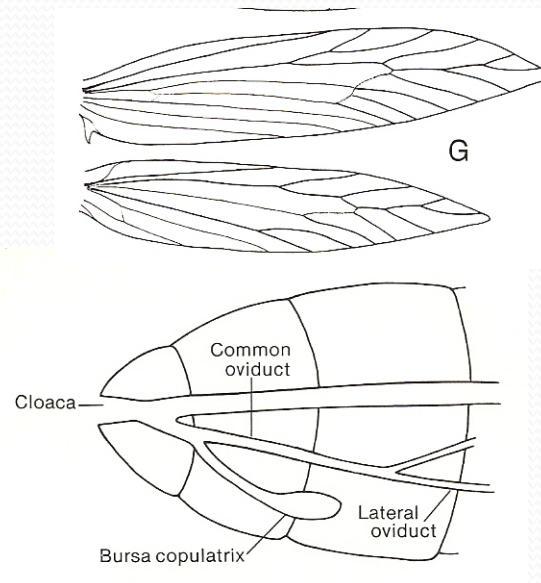
# Eriocraniidae (Glossata)

- 1 family with 24 described species
- Homoneurous wings; jugate wing coupling



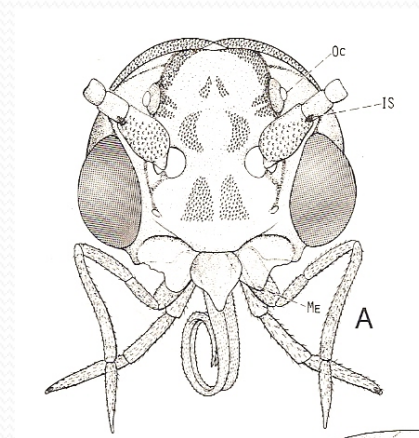
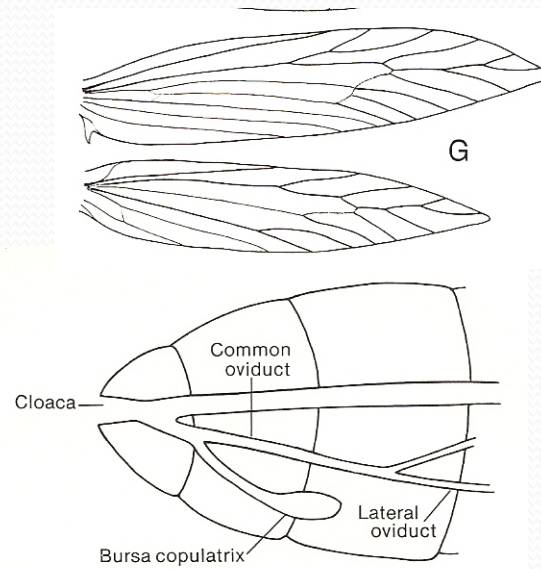
# Eriocraniidae (Glossata)

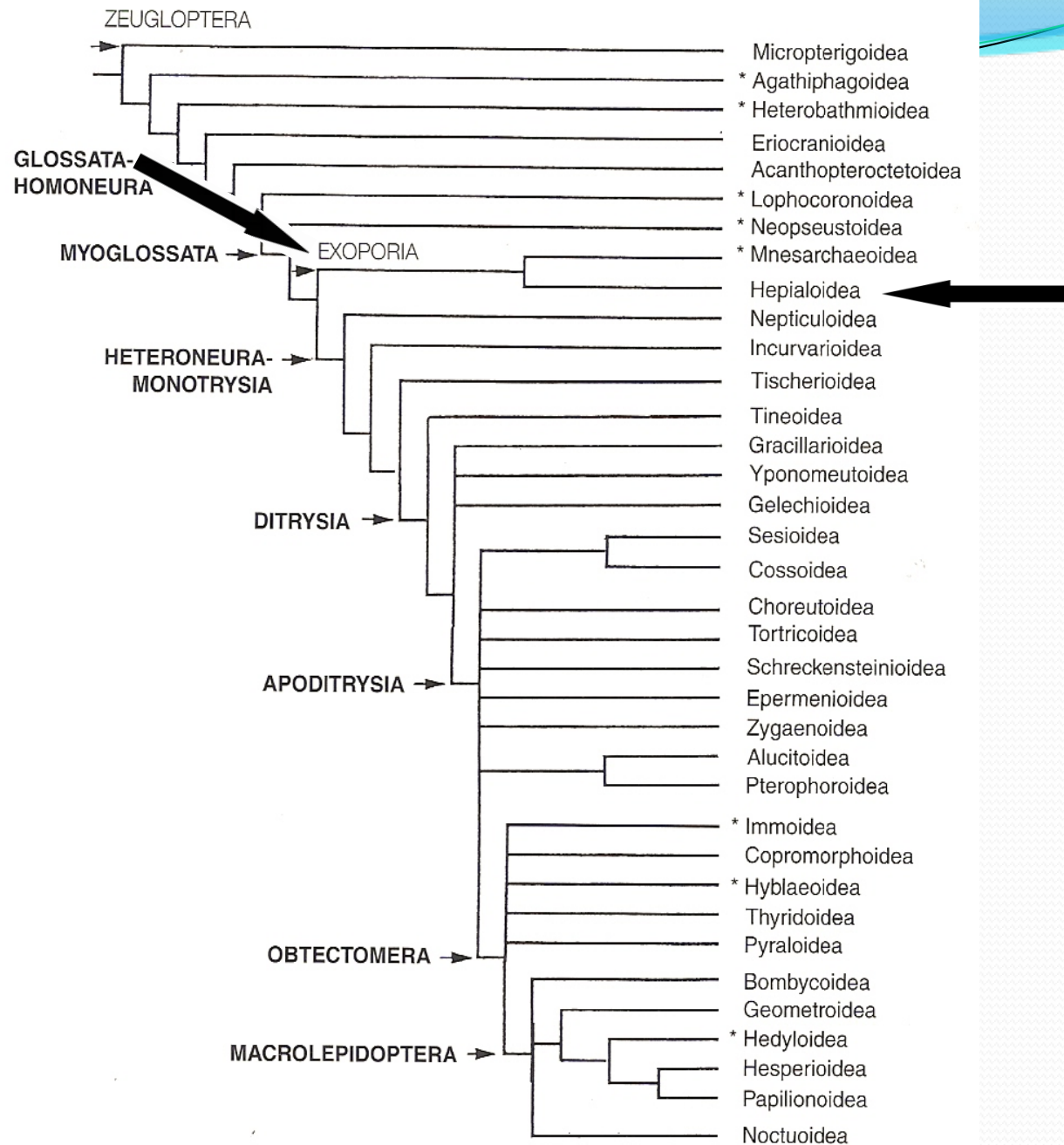
- 1 family with 24 described species
- Homoneurous wings; jugate wing coupling
- Monotrysian female reproductive system



# Eriocraniidae (Glossata)

- 1 family with 24 described species
- Homoneurous wings; jugate wing coupling
- Monotrysian female reproductive system
- Sucking mouthparts – non-functional mandibles, galea forming proboscis!





# Hepialoidea (Exoporia)

- 5 families with ca. 500 described species

Wingspan up to 25 cm

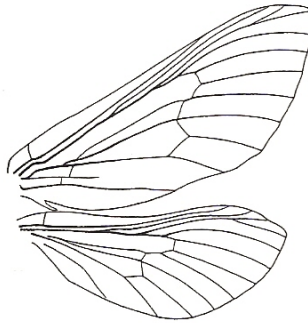
Adults crepuscular/nocturnal

As many as 30,000 eggs  
“broadcast” by female in flight



# Hepialoidea (Exoporia)

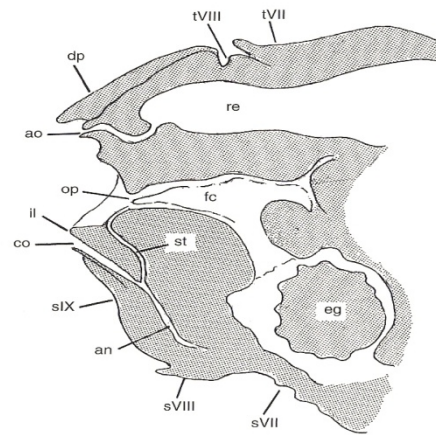
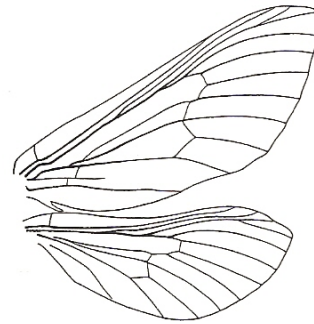
- 5 families with ca. 500 described species
- Homoneurous wings; jugate wing coupling



*Endoclita sinensis* female (dorsal surface)

# Hepialoidea (Exoporia)

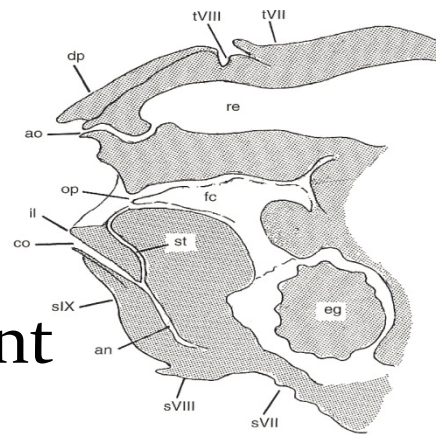
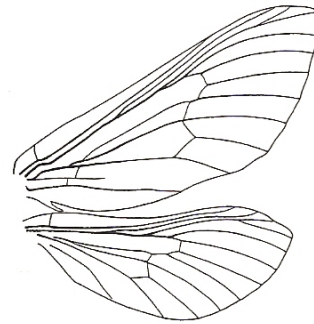
- 5 families with ca. 500 described species
- Homoneurous wings; jugate wing coupling
- Exoporian female reproductive system



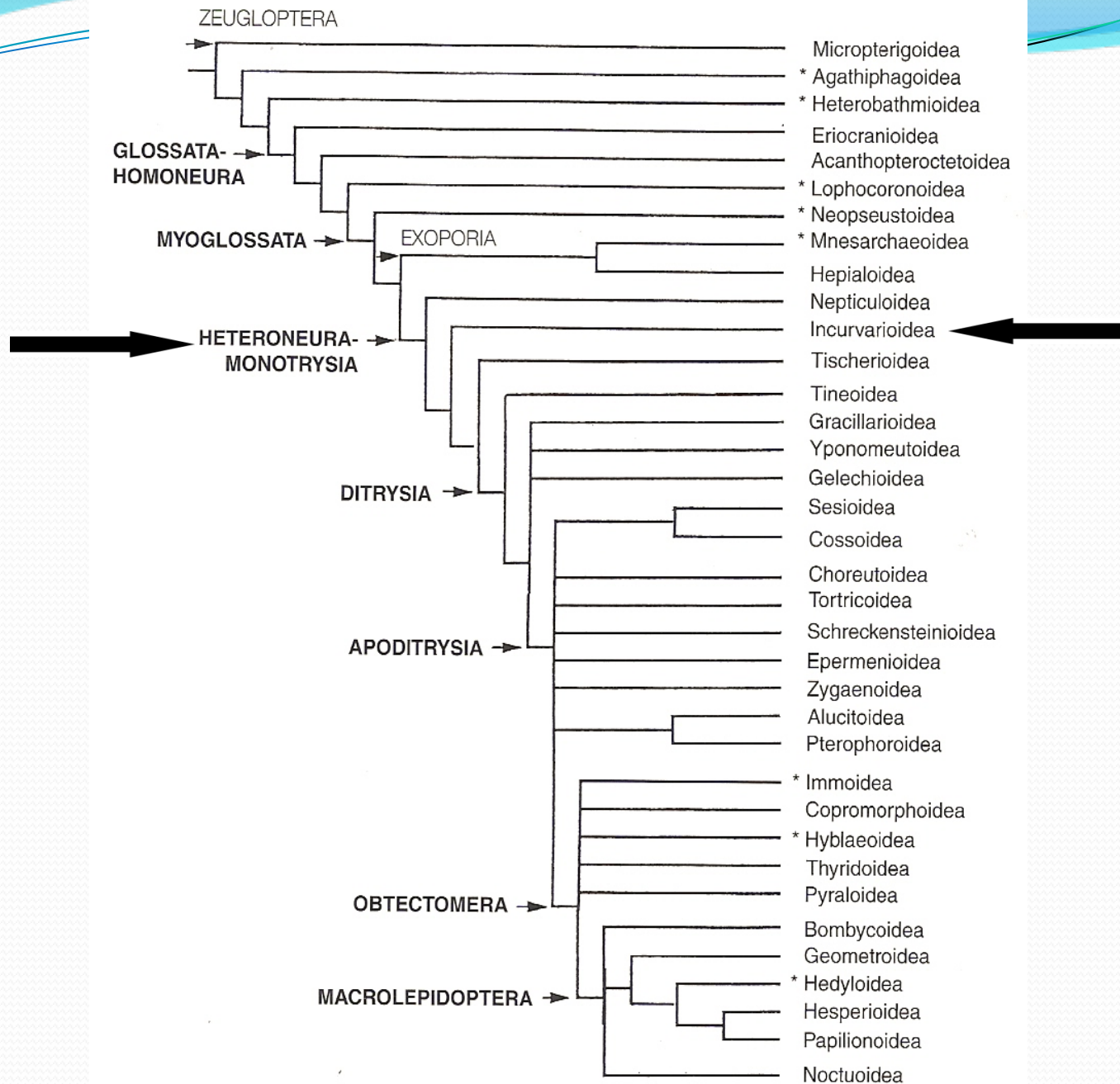
*Endocrita sinensis* female (dorsal surface)

# Hepialoidea (Exoporia)

- 5 families with ca. 500 described species
- Homoneurous wings; jugate wing coupling
- **Exoporian female reproductive system**
- Mouthparts reduced – proboscis short or absent



*Endocrita sinensis* female (dorsal surface)



# Adeloidea (Heteroneura - Monotrysia)

- 5 families with ca. 410 described species

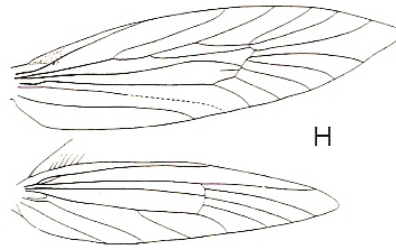
Heliozelidae, Adelidae (fairy moths), Prodoxidae (yucca moths), Cecidosidae, Incurvariidae

Small to tiny moths, forewing length 1.7-16 mm



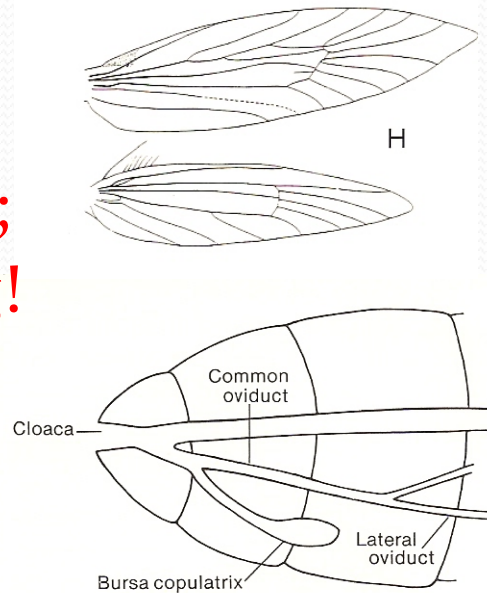
# Adeloidea (Heteroneura - Monotrysia)

- 5 families with ca. 410 described species
- Heteroneurous wings;  
frenate wing coupling!



# Adeloidea (Heteroneura - Monotrysia)

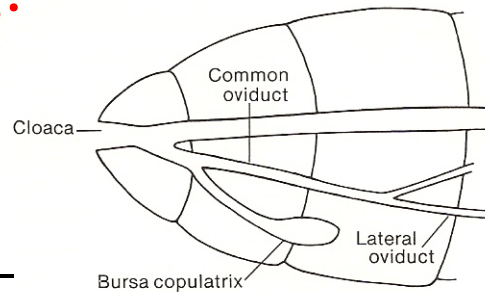
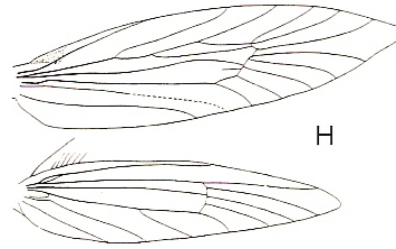
- 5 families with ca. 410 described species
- **Heteroneurous wings; frenate wing coupling!**
- Monotrysian female reproductive system



*Coptodisca arbutiella*  
Photo by Veronica Bura

# Adeloidea (Heteroneura - Monotrysia)

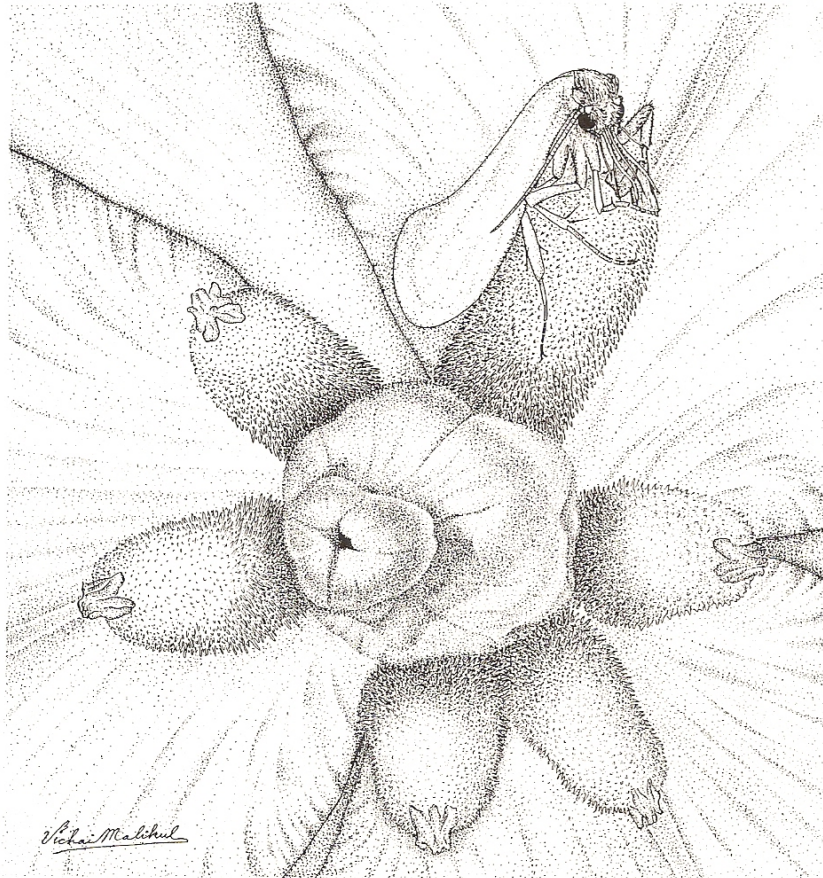
- 5 families with ca. 410 described species
- **Heteroneurous wings; frenate wing coupling!**
- Monotrysian female reproductive system
- Mouthparts reduced – proboscis short or absent (but wild in yucca moths)

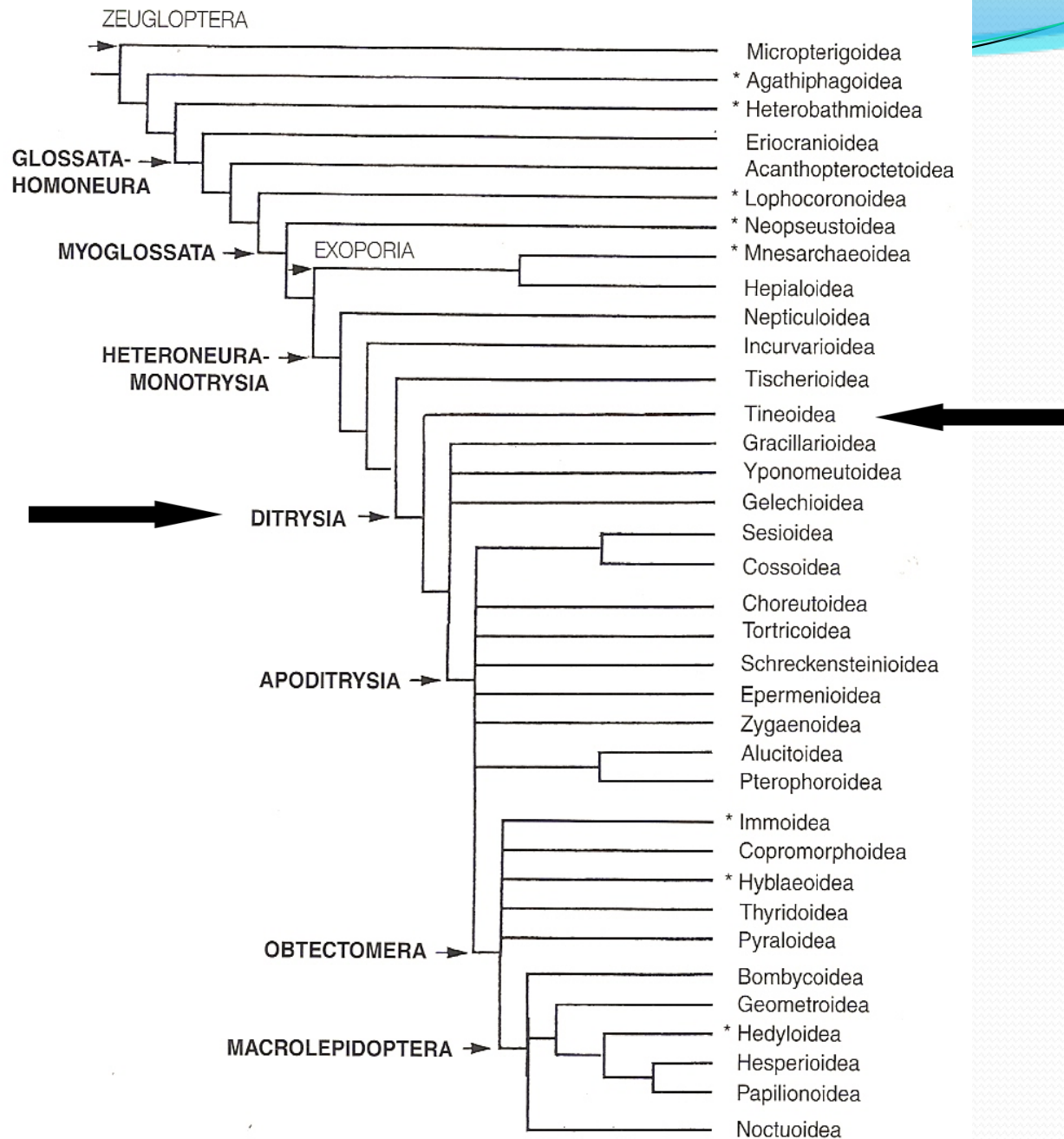


# Prodoxidae – yucca moths



Yuccas and  
yucca moths –  
a classic tale of  
symbiosis





# Tineiodea (Heteroneura - Ditryisia)

- 3 families with ca. 3,700 described species

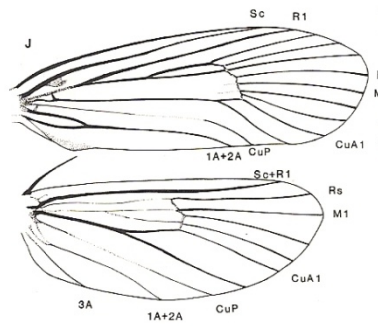
Tineidae (clthes moths),  
Eriocottidae, Psychidae  
(bagworms),

The most primitive ditrysians



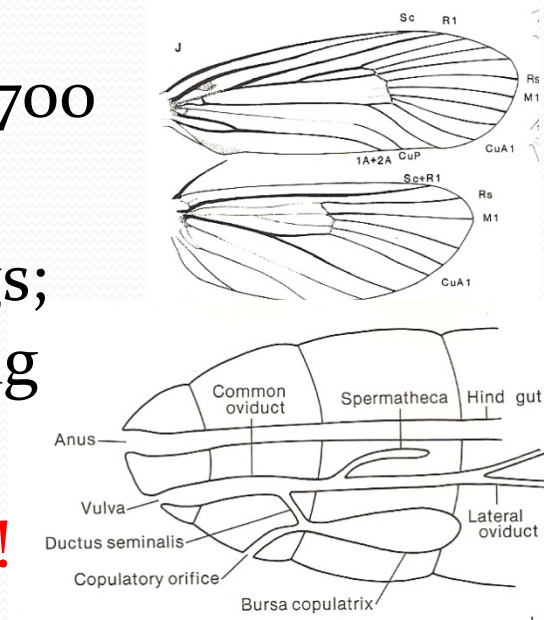
# Tineiodea (Heteroneura - Ditryisia)

- 3 families with ca. 3,700 described species
- Heteroneurous wings; frenate wing coupling



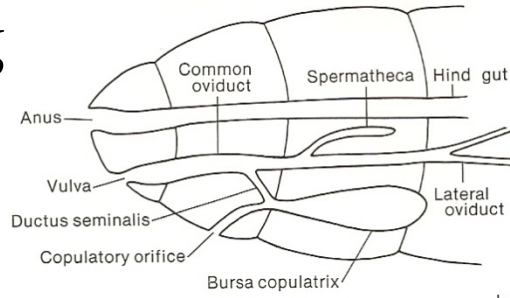
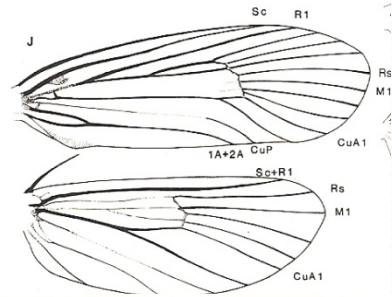
# Tineiodea (Heteroneura - Ditryisia)

- 3 families with ca. 3,700 described species
- Heteroneurous wings; frenate wing coupling
- **Ditryisian female reproductive system!**

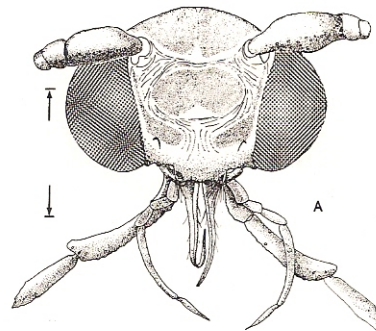


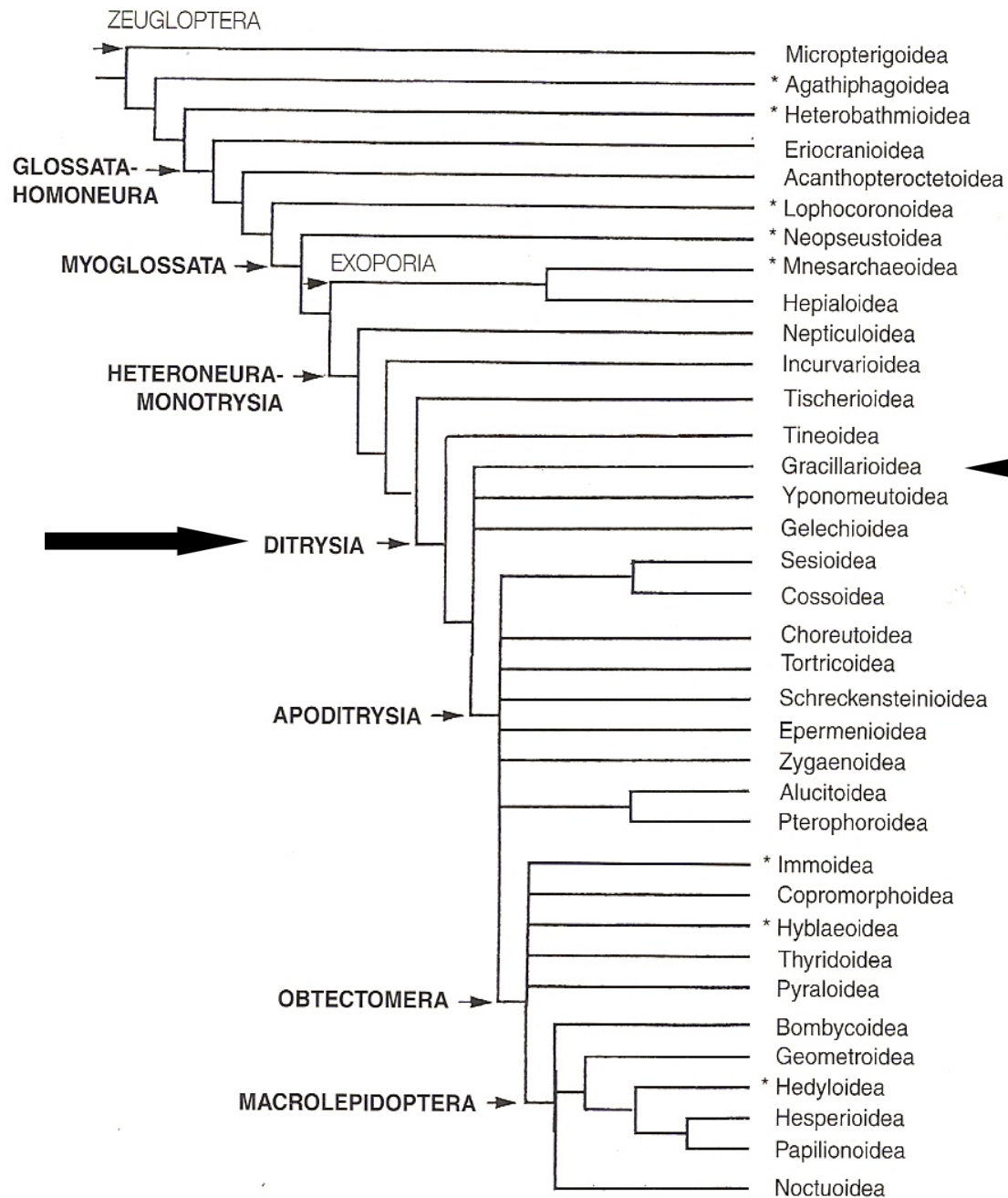
# Tineiodea (Heteroneura - Ditryisia)

- 3 families with ca. 3,700 described species
- Heteroneurous wings; frenate wing coupling
- **Ditryisian female reproductive system!**
- Mouthparts well developed – proboscis reduced



98





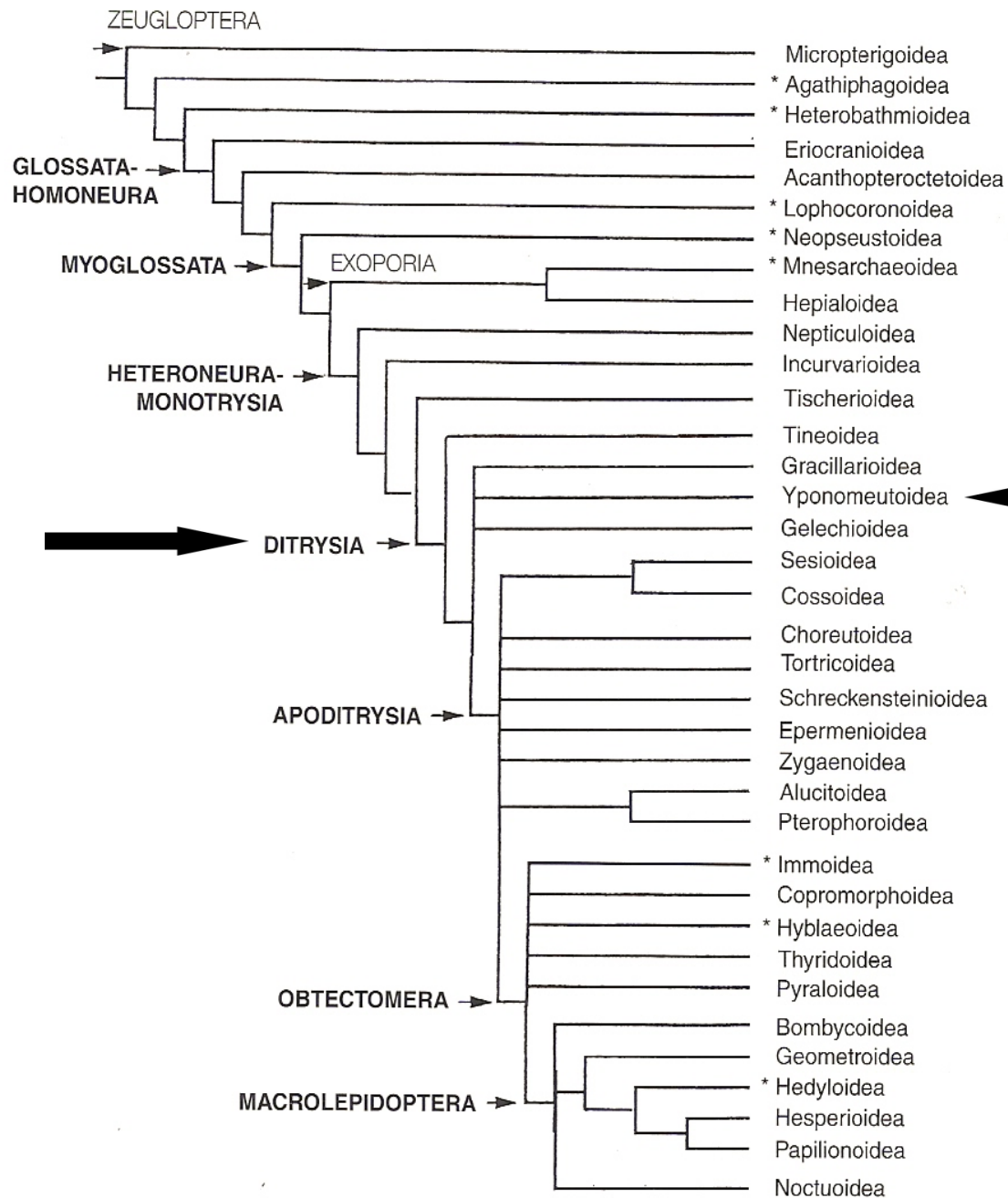
# Gracillarioidea (Heteroneura - Ditrysia)

- 3 families with ca. 2,200 described species (mostly Gracillariidae)
- Heteroneurous wings; frenate wing coupling
- Ditryisian female reproductive system
- Mouthparts well developed; labial palpi often with lateral bristles (also present in Tineidae)



Figure 41





# Yponomeutoidea (Heteroneura - Ditrysia)

- 10 families with ca. 1,735 described species

Classification historically unstable:

Yponomeutidae, Plutellidae,  
Ypsolophidae, Acrolepiidae,  
Glyphipterigidae, Argyresthiidae,  
Heliodinidae, Lyonetidae,  
Attevidae, Praydidae, Heliodinidae,  
Bedelliidae, Lyonetiidae

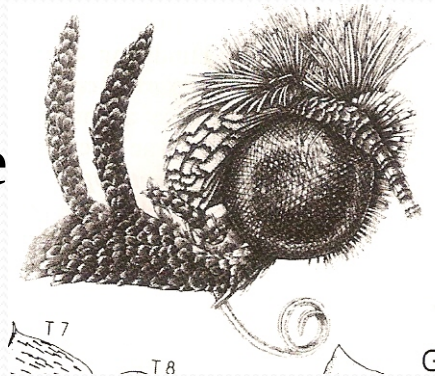
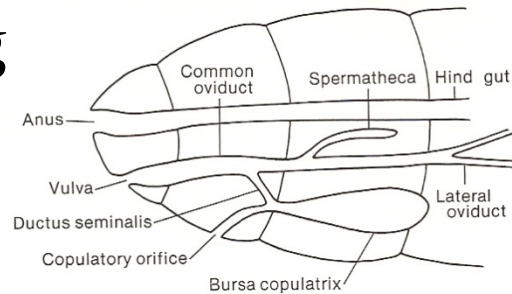
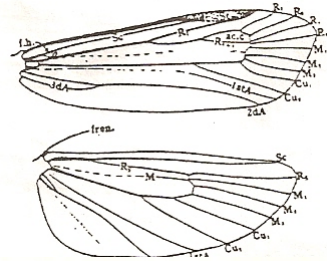
A heterogenous assemblage of relatively primitive micros.

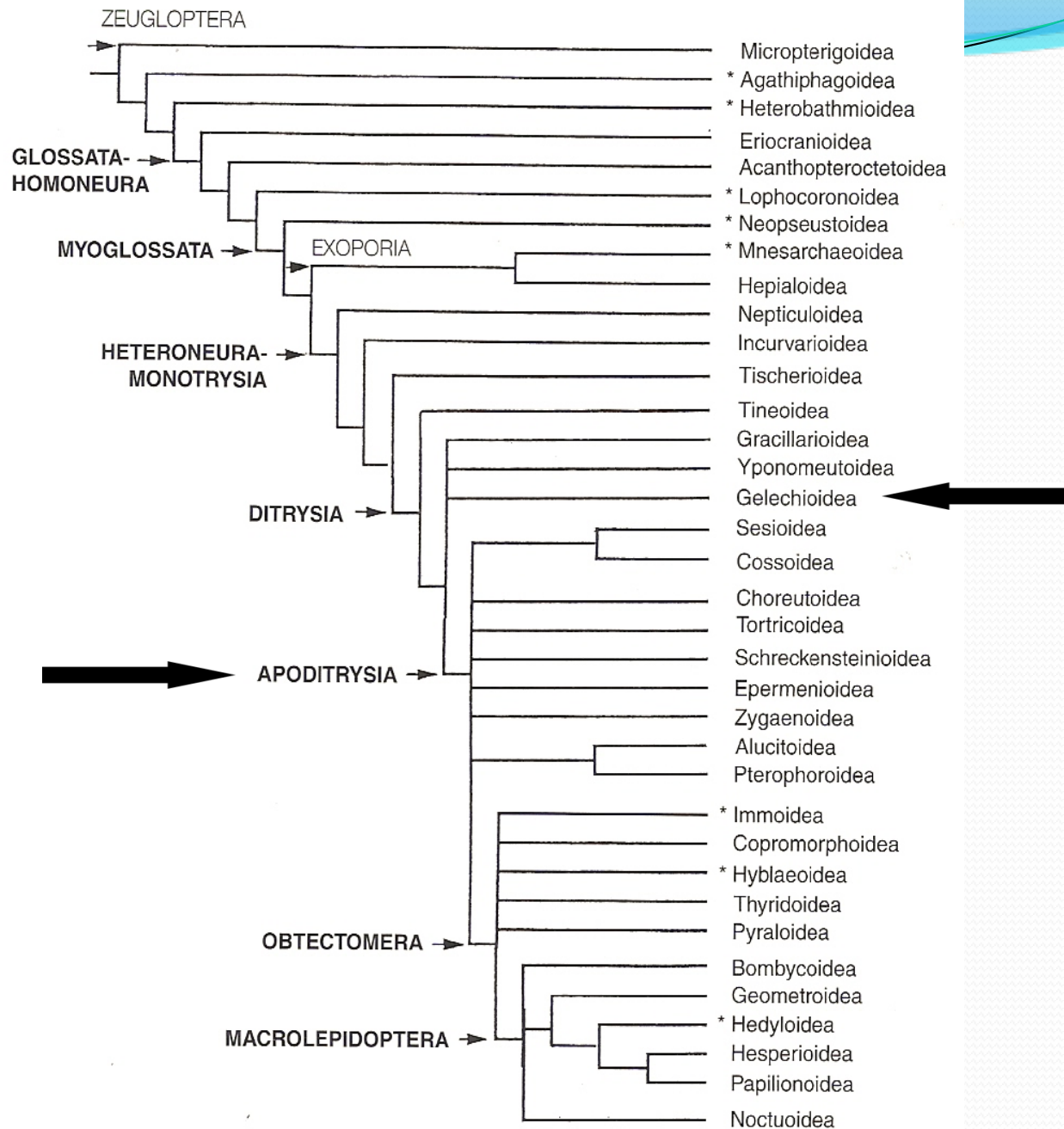
Autapomorphy: pleural lobes just before genitalia – posterior expansion of pleuron VIII



# Yponomeutoidea (Heteroneura - Ditrysia)

- 10 families with ca. 1,735 described species
- Heteroneurous wings; frenate wing coupling
- Ditryisian female reproductive system
- Mouthparts well developed; labial palpi variable but always large and conspicuous





# Gelechioidea (Heteroneura - Apoditrysia)

- 21 families with ca. 18,500 described species

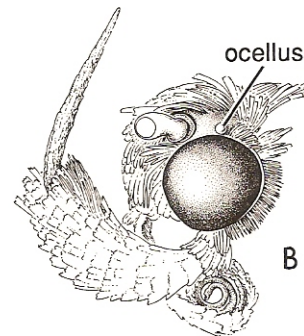
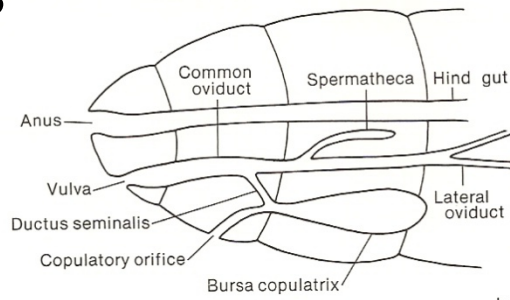
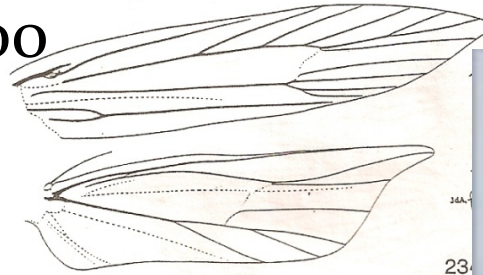
Classification historically unstable:

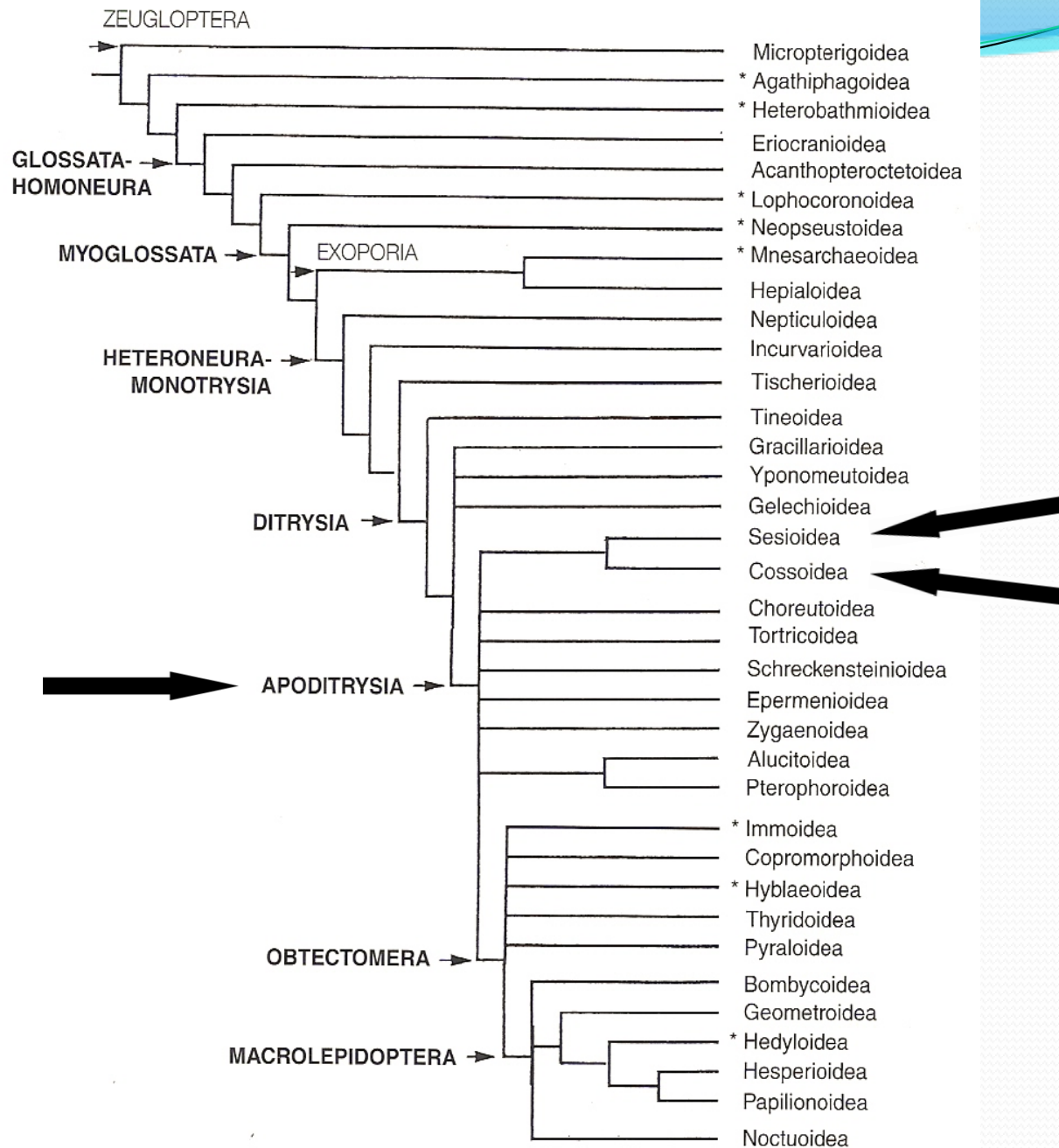
*Gelechiidae*, *Depressariidae*  
(*Stenommatinae*, *Ethmiinae*,  
*Depressariinae*, *Agonoxeninae*),  
*Elachistidae*, *Xyloryctidae*  
(*Scythridinae*) *Schistomeoidea*,  
*Oecophoridae* (*Stathmopodinae*),  
*Amphisbatidae*, *Lecithoceridae*,  
*Batrachedridae*, *Deocloniidae*,  
*Coleophoridae*, *Blastobasidae*,  
*Momphidae*, *Autostichidae*  
(*Symmocidae*), *Cosmopterigidae*,  
others?



# Gelechioidea (Heteroneura - Apoditrysia)

- 21 families with ca. 18,500 described species
- Heteroneurous wings; frenate wing coupling
- Ditryisian female reproductive system
- Mouthparts well developed; labial palpi large, upturned





# Cossoidea (Heteroneura - Apoditrysia)

- 7 families with ca. 2,870 described species

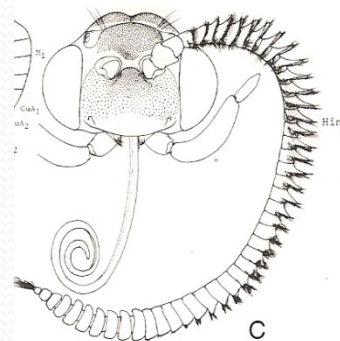
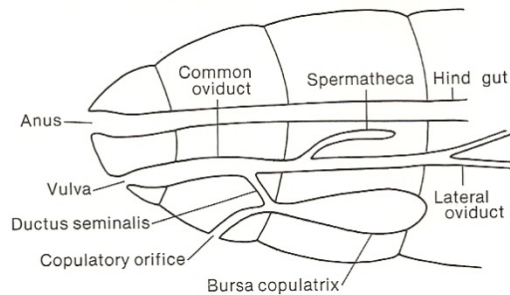
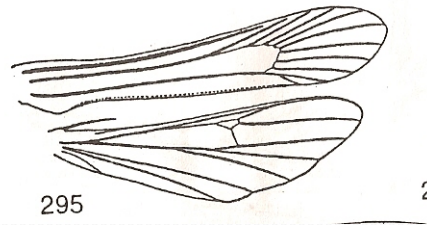
Cossidae, Brachodidae,  
Dudgeoneidae, Metarbelidae,  
Retardidae, Castniidae, Sesiidae

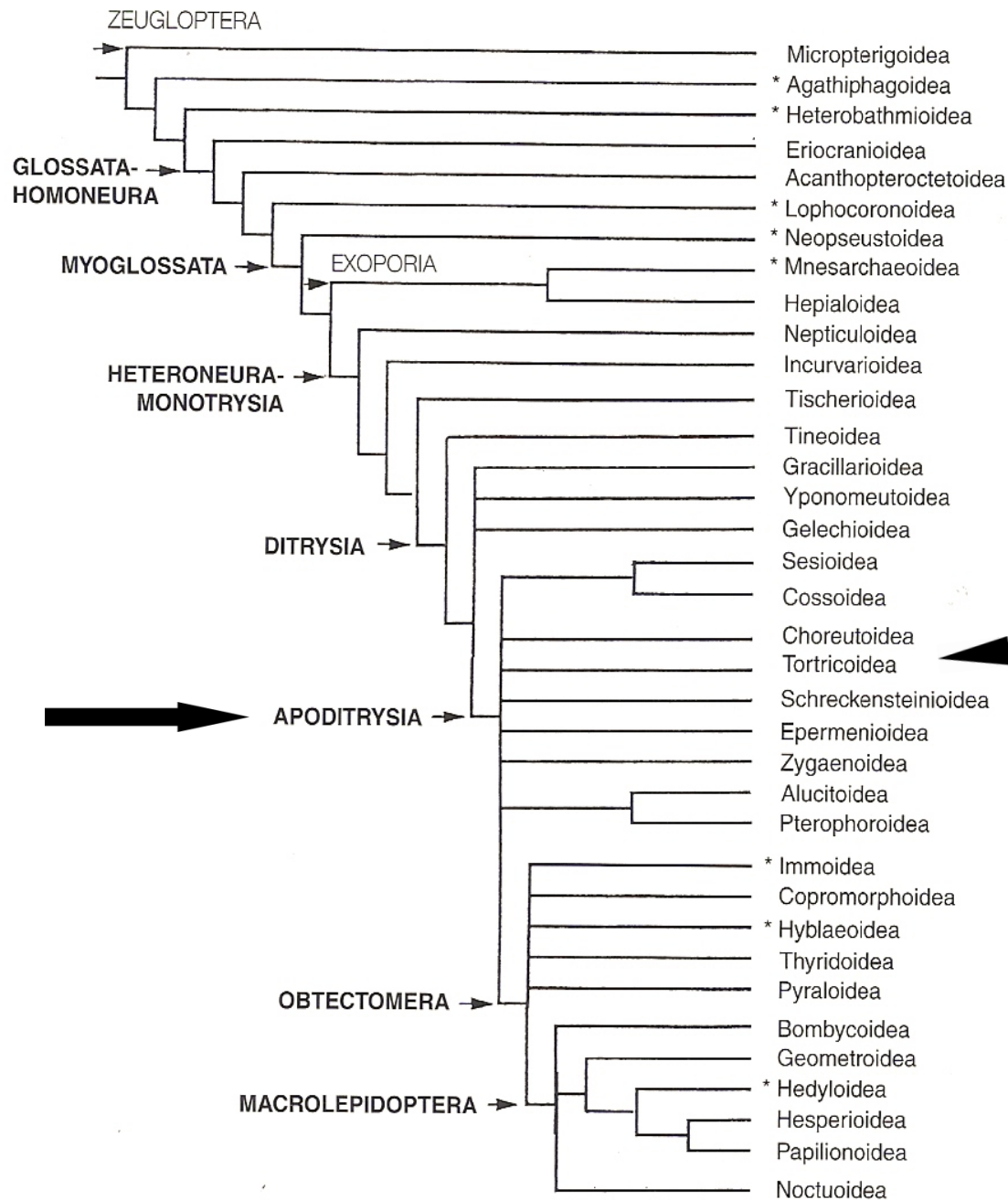
Wood-boring larvae (mostly)



# Cossoidea (Heteroneura - Apoditrysia)

- 7 families with ca. 2,870 described species
- Heteroneurous wings; frenate wing coupling (retinaculo-frenate in Sesiidae)
- Ditrysiian female reproductive system
- Mouthparts well developed





# Tortricoidea (Apoditrysia)

- 1 family with ca. 11,000 described species

Two major subfamilies previously considered families:

Olethreutidae

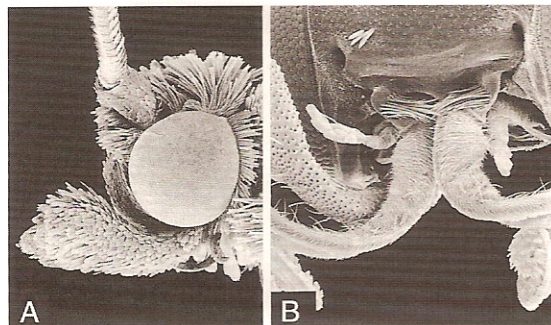
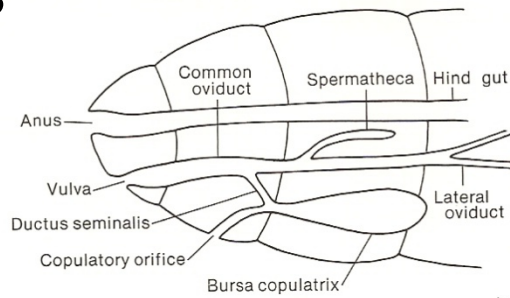
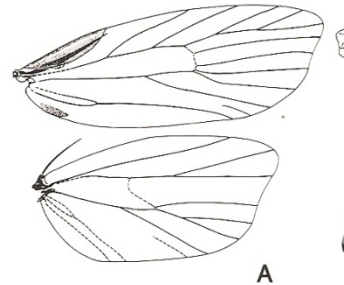
Tortricidae

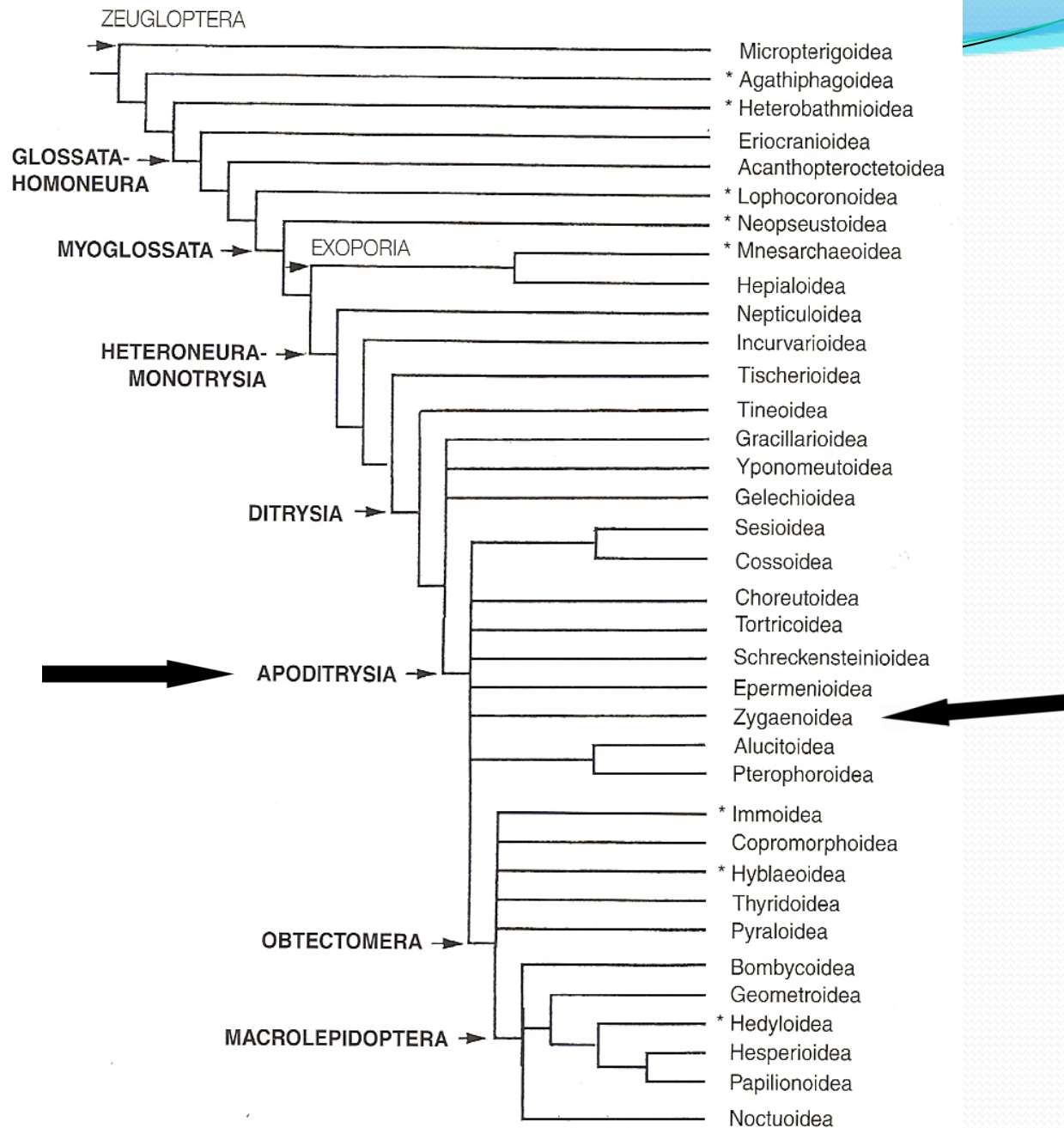
Many economically important pests – spruce bud worm, codling moth, light brown apple moth, European grape berry moth



# Tortricoidea (Apoditrysia)

- 1 family with ca. 10,000 described species
- Heteroneurous wings; frenate wing coupling
- Ditryisian female reproductive system
- Mouthparts well developed





# Zygaenoidea (Apoditrysia)

- 12 families with ca. 2,700 described species

Small to medium sized fuzzy  
moths (Limaecodidae,  
Megalopygidae, Dalceridae)

Bizarre larvae (Limaecodidae,  
Megalopygidae, Dalceridae)

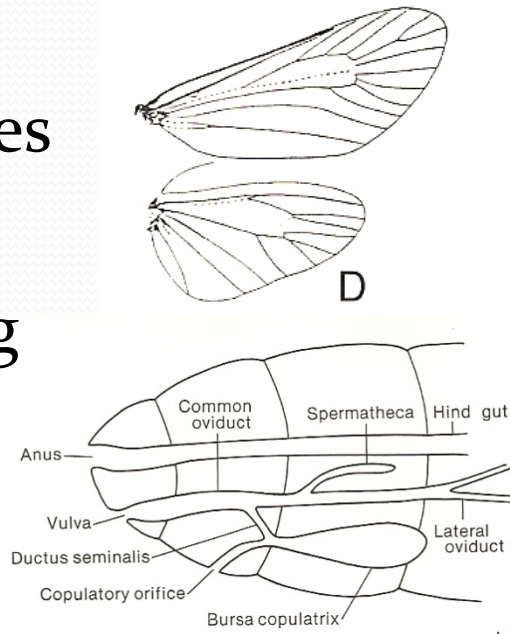
Many Zygaenidae are diurnal

Epipyropidae are ectoparasites on  
Homoptera



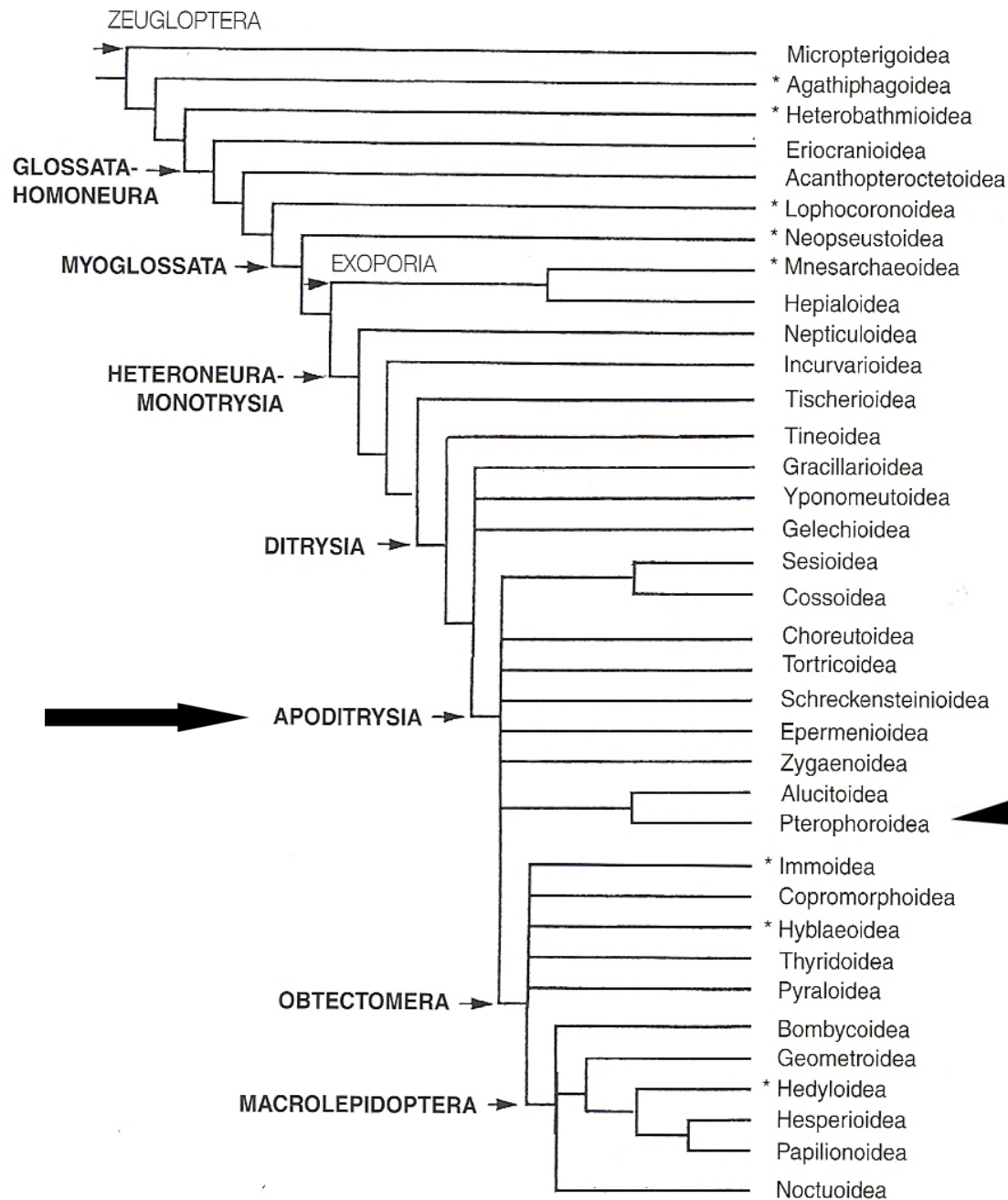
# Zygaenoidea (Apoditrysia)

- 12 families with ca. 2,700 described species
- Heteroneurous wings
- Frenate wing coupling
- Ditrysian female reproductive system
- Palpi reduced, proboscis present



# Limacodidae larvae – bizarre!





# Pterophoroidea (Apoditrysia)

- 1 family with ca. 1,000 described species

Characteristically incised wings

Long slender legs

Distinctive resting posture



# Pterophoridae (Apoditrysia)

- 1 family with ca. 1,000 described species
- Heteroneurous wings; frenate wing coupling
- Ditrysian female reproductive system
- Labial palpi variable in shape and vestiture

